Biological Opinion

Impacts to Running Buffalo Clover from the U.S. Army Corps of Engineers' Approval of the Northern Kentucky University Center for Environmental Restoration Kingsolver Stream Restoration Project in Nicholas County, Kentucky

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February 6, 2019
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CONSULTATION HISTORY

This section lists key events and correspondence during the course of this consultation. A complete administrative record of this consultation is on file in the Service's Kentucky Field Office.

May 3, 2018	NKU CER shared a digital version of the draft mitigation plan for the Kingsolver site with the Service. The appendices to this document included a Biological Assessment (BA), dated December 2015, stating that the project was likely to adversely affect running buffalo clover (*Trifolium stoloniferum*).
May 7, 2018	After its review of the draft mitigation plan and BA, the Service emailed the Corps recommending early coordination to discuss effects to running buffalo clover.
June 22, 2018	In a conference call, the Service, the Corps, and NKU CER discussed the proposed project and decided that the Service would conduct a site visit with NKU CER and NKU CER would update the BA based on current information.
June 27, 2018	NKU CER emailed an updated draft BA, dated June 2018, for the project.
June 28, 2018	The Service conducted a site visit with NKU CER and Kentucky Department of Fish and Wildlife Resources staff.
August 3, 2018	NKU CER sent the Service an email with an attached updated BA, dated August 2018, and other supporting documents.
August 9, 2018	NKU CER emailed the Service information about the size of each of the running buffalo clover patches in the Action Area.
September 25, 2018	The Service received a letter from the Corps requesting initiation of formal consultation on running buffalo clover as a result of the proposed Action with an attached final August 2018 BA.
October 9, 2018	The Service emailed a letter to the Corps agreeing that the BA contained sufficient information to initiate formal consultation on impacts to running buffalo clover, and formal consultation was initiated.
January 31, 2019	The Service submitted a draft Biological Opinion (BO) to the Corps.
February 5, 2019	The Corps informed the Service that it had no comments on the draft BO.

BIOLOGICAL OPINION

1. INTRODUCTION

A biological opinion (BO) is the document that states the opinion of the U.S. Fish and Wildlife Service (Service) under the Endangered Species Act of 1973, as amended (ESA), as to whether a Federal action is likely to:

a) jeopardize the continued existence of species listed as endangered or threatened, or
b) result in the destruction or adverse modification of designated critical habitat.

The U.S. Army Corps of Engineers (Corps) is evaluating the Northern Kentucky University Center for Environmental Restoration's (NKU CER) proposed Kingsolver site for approval as a stream mitigation in-lieu fee site under NKU CER's Mitigation Banking Instrument. If approved, the site would provide stream credits to mitigate for impacts to streams at off-site locations in NKU CER's service area. This BO considers the effects of the Action on the running buffalo clover.

The Service has not designated critical habitat for the running buffalo clover; therefore, this BO does not further address critical habitat.

A BO evaluates the effects of a Federal Action, along with those effects resulting from interrelated and interdependent actions and effects from non-federal actions unrelated to the Action (cumulative effects), relative to the status of listed species and the status of designated critical habitat. A Service BO that concludes a proposed Federal action is *not* likely to jeopardize species and is *not* likely to destroy or adversely modify critical habitat fulfills the Federal agency's responsibilities under §7(a)(2) of the ESA of 1973, as amended.

"*Jeopardize the continued existence*" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02). "*Destruction or adverse modification*" means a direct or indirect alteration that appreciably diminishes the value of designated critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features (50 CFR §402.02).

2. PROPOSED ACTION

The federal action evaluated in this BO is the Corps' potential approval of the proposed Kingsolver stream mitigation site under the Agreement Concerning In-Lieu Mitigation Fees between the Corps, NKU-CER, and Northern Kentucky University Research Foundation (LRL-2010-326). If approved, NKU CER would restore, enhance, and preserve streams on the site as proposed in the Mitigation Plan to benefit aquatic restores. This proposed work would be

interrelated/interdependent to the Corps' potential approval of the site and, together with that potential approval, will be collectively referred to in this BO as the "Action."

2.1. Action Area

For purposes of consultation under ESA §7, the Action Area is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR §402.02).

The Service is defining the Action Area as the 945-acre conservation area that contains the streams proposed for restoration or preservation (Fig. 1).

2.2. Components of the Action

As stated above, the Action is the Corps' approval of the proposed mitigation site. This approval would authorize NKU CER to apply the mitigation types proposed in the Mitigation Plan to the streams in the Action Area (Fig. 1):

- Re-establishment of 316 linear feet (lf) of intermittent stream and 1,195 lf of ephemeral stream,
- Rehabilitation of 12,371 lf of intermittent stream and 3,501 lf of ephemeral stream,
- Natural recovery of 1,554 lf of perennial stream and 3,529 lf of ephemeral stream, and
- Preservation of 932 lf of perennial stream, 711 lf of intermittent stream, and 44,487 lf of ephemeral stream.

The activities associated with applying these mitigation types are separated into the following categories: construction, planting, maintenance and monitoring, site protection, and long-term monitoring.

2.2.1. Construction Activities

Construction of the entire site is estimated to take two years, but will be divided into four phases beginning with the most upstream reach in the watershed and progressing downstream. Construction activities will occur on the stream reaches proposed for re-establishment and rehabilitation. The degree of disturbance that will occur varies according to the type of mitigation that is proposed:

- *Re-establishment* will be applied only on short segments of stream. The work will include dam, sediment, or fill removal with replacement of rock substrate on reaches with zero initial stream flow/quality. These reaches will gain both function and linear feet.
- *Rehabilitation* will be accomplished through floodplain excavation, bank stabilization, and/or addition of rock substrate. These reaches will gain function but not linear feet.

Construction typically involves the following activities: 1) grubbing, 2) grading and filling, 3) excavation, and 4) placement of structures. These are discussed in more detail below.

Grubbing

Grubbing will occur along linear corridors along the riparian zone. In rehabilitation reaches, the areas of disturbance for streambank regrading will extend out 20 feet or less from each side of the stream. Re-establishment reaches will likely have wider disturbance areas because the existing channel will be relocated to a new alignment. A small amount of additional grubbing may be required to provide access to construction areas on site and equipment staging areas. Grubbing could affect running buffalo clover by exposing it to the following stressors: crushing, soil compaction, and change in light regimes.

Grading and filling

Stream banks will be graded to re-connect the stream with the floodplain. The smallest equipment practicable will be utilized to minimize damage to existing vegetation and provide more maneuverability, such as small- to medium-sized (5-20 tons) excavators, small tracked trucks for material transport, small skid steer loaders, and haul trucks. Grading and filling could affect running buffalo clover by exposing it to the following stressors: crushing, soil compaction, and soil disturbance.

Excavation

In re-establishment reaches, dams, sediment, or fill will be removed. Portions of channels in reaches of all mitigation types may be excavated to create pools and riffles. Excavation could affect running buffalo clover by exposing it to the following stressors: crushing, soil compaction, and soil disturbance.

Placement of structures

Approximately 1,031 tons of cyclopene limestone rock will be installed in the channel to create riffles. Placement of structures could affect running buffalo clover plants by exposing it to the following stressors: crushing and soil compaction.

2.2.2. Planting

After construction is completed, native trees and shrubs will be planted in riparian areas that are not already forested. All perennial and intermittent streams will have a riparian buffer that is a minimum of 50 feet wide extending out from the top of each bank. All ephemeral stream buffers will be a minimum of 25 feet wide from each bank. Planting could affect running buffalo clover plants by exposing it to changes in light regimes, a stressor.

2.2.3. Monitoring & Maintenance

NKU CER will monitor the site for five years after construction. Monitoring parameters will quantify the stability of stream channels and establishment of vegetation. Corrective measures will be implemented if the Corps finds that approved performance standards are not being met. Typical corrective measures include spot treatment to repair stream bank instability, invasive species control, and additional plantings. The invasive species control would benefit running buffalo clover and could affect it by exposure to herbicide, a stressor.

2.2.4. Site Protection

A conservation deed restriction will be placed on the mitigation areas. The deed restriction will be similar to the template developed by the Corps and the Kentucky Energy and Environment Cabinet, Department of Environmental Protection, Division of Water that can be found at the following website: http://water.ky.gov/permitting/Pages/StreamWetlandDoc.aspx. When the project is completed and determined successful after the monitoring period, the property will be transferred to the Kentucky Department of Fish and Wildlife Resources. Site protection would benefit running buffalo clover by prohibiting activities that could impact the species and its habitat (e.g., logging, development). In some cases, removal of certain activities that create periodic disturbance upon which the species thrives (e.g., ATV use, grazing) can negatively affect running buffalo clover. This is not anticipated for the running buffalo clover at the Kingsolver site, because the plants are growing in areas that receive disturbance from stream scour.

2.2.5. Long-term Management

The site will be managed long-term according to the specific needs of the site and may include fence repair, signage, invasive species treatment, easement monitoring and enforcement. NKU CER will monitor running buffalo clover patches in the Action Area during this time.

2.2.6. Conservation Measures

Conservation measures are those proposed actions taken to benefit or promote the recovery of the species. These are actions taken by the federal agency or the applicant to minimize or offset effects on the species under review and are included as an integral portion of the Action. NKU CER has committed to implement the following conservation measures as part of the Action:

- Tree removal will be avoided whenever possible to maintain existing light regimes.
- Grading, filling, and excavation will avoid all recorded running buffalo clover patches, except one.
- Access roads will be routed to avoid most running buffalo clover.
- Wooden construction mats or plywood will be used to cover running buffalo clover plants if equipment needs to be moved across them to more broadly distribute equipment weight across the soil and plants.
- Running buffalo clover patches will be demarcated with flagging tape to reduce chances of accidental disturbance.
- Herbicide applications on invasive species (primarily Amur honeysuckle (*Lonicera maackii*) and multiflora rose (*Rosa multiflora*)) will be conducted during the winter months by certified pesticide applicators who are trained at identifying running buffalo clover. If herbicide applications need to occur within three feet of running buffalo clover, it will be applied to target species using sponges or brushes.
- All construction equipment will be free from dirt before arrival at the site to prevent the spread of invasive species.
- Construction activities will be timed so that running buffalo clover patches are not disturbed during the flowering season (April 15 – June 15).
- Running buffalo clover patch #10 will be relocated prior to construction. NKU CER will use hand shovels to dig up the plants and relocate them to other suitable habitat in the Action Area and water the transplanted plants.

- NKU CER will monitor the running buffalo clover patches throughout the construction process and during the 5-year mitigation monitoring period and report findings to the Service.

2.3. Interrelated and Interdependent Actions

A BO evaluates the effects of a proposed federal action. For purposes of consultation under ESA §7, the effects of a federal action on listed species or critical habitat include the direct and indirect effects caused by the Action, plus the direct and indirect effects caused by interrelated or interdependent actions. "Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration" (50 CFR §402.02).

In its request for consultation, the Corps did not describe, and the Service is not aware of, any interrelated or interdependent actions in addition to the components of the Action already described in section 2.2.

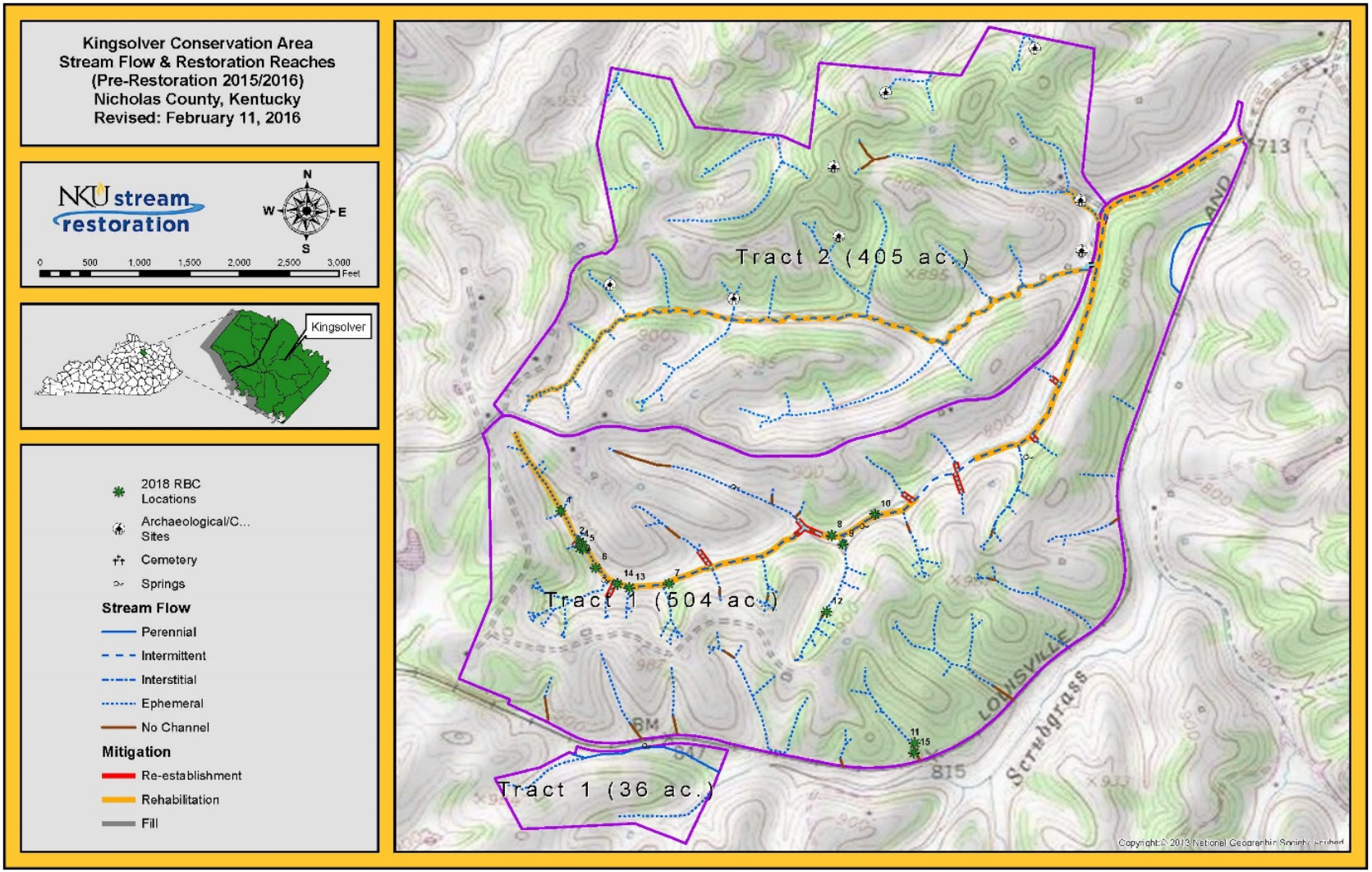

Figure 1: The 945-acre conservation area that contains the streams proposed for restoration or preservation (figure prepared by NKU CER).

3. STATUS OF THE SPECIES

This section summarizes best available data about the biology and current condition of running buffalo clover (*Trifolium stoloniferum*) throughout its range that are relevant to formulating an opinion about the Action. The Service published its decision to list running buffalo clover as endangered on July 6, 1987 (50 FR 21478-21480) under the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.). Critical habitat has not been designated for the species. The Service revised the Recovery Plan in 2007 (USFWS 2007) and initiated a 5-year status review in 2015. The Revised Recovery Plan provides a comprehensive summary of the species and is incorporated by reference.

3.1. Species Description

Running buffalo clover plants produce erect flowering stems, 10-30 cm (3.9-11.8 in.) tall that send out long basal runners (stolons) that root at the nodes (Fig. 2). The leaves of the runners have 1-2 cm (0.4-0.8 in.) long ovate-lanceolate stipules, whose tips gradually narrow to a distinctive point (attenuate tip). Erect stems arise from nodes along the stolon with two large trifoliolate leaves at their summit. Obovate leaflets measure 2-3 cm (0.8-1.2 in.) long and wide (Gleason and Cronquist 1991). Flowering stalks (peduncles) originate from the upper axils, producing 9-12 mm (0.35-0.47 in.) round (sub-globose) flower heads. The white, purple-tinged corolla exceeds the calyx (Gleason and Cronquist 1991). Brooks (1983) provides a discussion of morphological and distinguishing features for this and related clover species.

Because of the stoloniferous growth form, individual plants can be difficult to distinguish. The Running Buffalo Clover Recovery Team has defined an individual plant as a rooted crown. A rooted crown is a rosette that is rooted into the ground (Fig. 2). Rooted crowns may occur alone or be connected to other rooted crowns by stolons (runners).

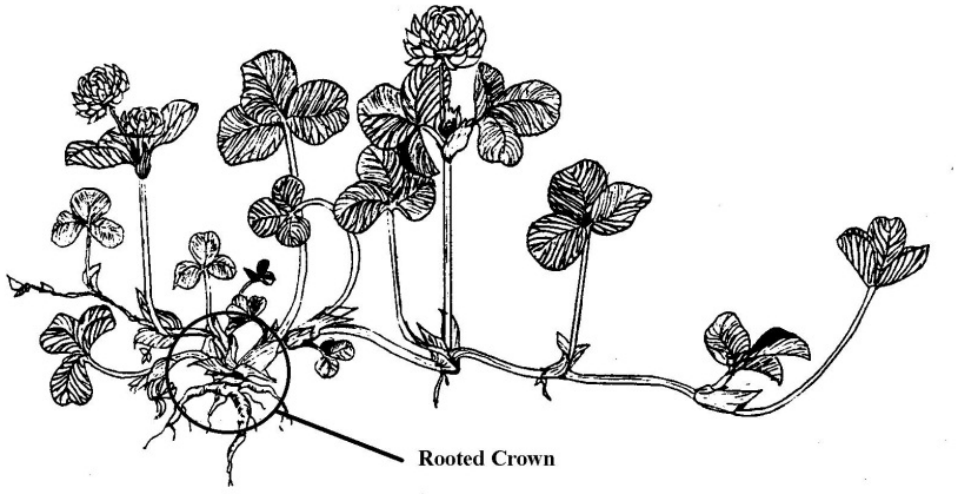

Figure 2. Structure of running buffalo clover showing a rooted crown (Ethel Hickey; reprinted from Revised Recovery Plan (USFWS 2007)).

3.2. Life History

Running buffalo clover usually acts as a perennial species with a growth form that includes rooted crowns and stolons. Unrooted "daughter crowns" that develop along the stolons begin to root forming new rooted crowns that eventually disconnect from the "parent" crown. There is substantial variability in the timing and amount of growth of running buffalo clover.

Running buffalo clover flowers from mid-April to June; fruiting occurs from May to July (Brooks 1983). Running buffalo clover is reported to be visited by bees (*Apis mellifera* and *Bombus* spp.) and is cross-pollinated under field conditions (Taylor et al. 1994). Franklin (1998) documented that although running buffalo clover is genetically self-compatible, the pollen needs to be transferred by an outside agent (pollinator) in order for seeds to set successfully. Taylor et al. (1994) suggested that running buffalo clover sets fewer seeds by self-pollination than by outcrossing, but that selfed seed set may be adequate to maintain the species in the wild. Although researchers have speculated that inbreeding depression may have contributed to the decline of running buffalo clover (Hickey et al. 1991, Taylor et al. 1994), selfed seeds have been shown to germinate well and developed into vigorous plants (Franklin 1998).

Average seed production per inflorescence in patches can vary greatly, from 4.3 to 68.6 seeds (Franklin 1998). Higher light availability in more open habitats may attract more pollinators, increasing pollination success, and result in higher seed production (Franklin 1998). Scarification is apparently essential for germination of running buffalo clover seeds. Little or no germination was observed in unscarified seeds, whereas 90%-100% germination was noted for scarified seeds (Campbell et al. 1988). Hattenbach (1996) found that sulfuric acid was a more efficient scarification agent than mechanical methods.

Unlike all other species within the genus *Trifolium*, running buffalo clover lacks a rhizobial associate (Campbell et al.1988, Morris et al. 2002). Research suggests that running buffalo clover may have a low nitrogen requirement and may, therefore, never have developed the need for a rhizobial associate (Morris et al. 2002). Running buffalo clover plants appear robust and healthy in many situations even without such an associate (Morris et al. 2002).

3.3. Habitat of Running Buffalo Clover

Running buffalo clover is usually found in mesic habitats with partial to filtered sunlight and a prolonged pattern of moderate and periodic disturbance, such as grazing, mowing, trampling, selective logging, or flood-scouring. Running buffalo clover is often found in regions with limestone or other calcareous bedrock underlying the site, though limestone soil is not a requisite determining factor for the locations of populations of this species. Populations of running buffalo clover have been found in a variety of habitat types, including mesic woodlands, streambanks, grazed woodlots, mowed paths, old logging roads, trails, mowed wildlife openings within mature forests, savannahs, sandbars, and steep ravines (USFWS 2007, 2008). This species can also be found on infrequently-used ATV trails and gravel drives.

At the time of European settlement of North America, running buffalo clover is thought to have been dependent on the once-common bison, or other large mammals, such as elk and deer, for seed scarification and dispersal, and for the maintenance of moderately disturbed habitat along large game trails (Campbell et al. 1988, Cusick 1989).

3.4. Status and Distribution of Running Buffalo Clover

For recovery purposes, running buffalo clover's range is divided into three regions based on proximity to each other and overall habitat similarities: Appalachian (West Virginia, and southeastern Ohio), Bluegrass (southwestern Ohio, central Kentucky and Indiana), and Ozark (Missouri). The majority of populations occur within the Appalachian and Bluegrass regions. Currently there are 153 populations of running buffalo clover distributed across all three regions, in six states: 58 populations in West Virginia, 50 in Kentucky, 33 in Ohio, 6 in Indiana, 5 in Missouri, and 1 in Pennsylvania (USFWS 2017, Jennifer Finfera, per. comm., 2017). Populations are ranked according to number of individuals and habitat quality (Table 1). Of the extant populations (excluding a recently discovered one from Pennsylvania), 16 are A-ranked, 35 B-ranked, 42 C-ranked, and 59 D-ranked.

While new populations are being discovered almost annually, monitoring of both new and existing populations occurs infrequently because of limited resources. Some populations are continuing to decline despite frequent management. Some populations have declined with some sites lacking plants for multiple years despite multiple monitoring events, while other populations have reappeared after they had not been observed for several years (USFWS 2017).

Table 1. Running buffalo clover population occurrence ranking categories (USFWS 2007).

Rank	
A	Population has 1,000 or more naturally occurring rooted crowns. Plants occur in natural suitable habitat (mesic woodland or river terraces) where the disturbance regime is maintained by natural processes (such as large mammal trampling, canopy gap creation, stream scouring); **or** in somewhat suitable habitat maintained by anthropogenic activities (old roads, jeep trails, "skidder" trails) where disturbance for a prolonged period (such as grazing, trampling, light logging traffic) is mild to moderate.
B	Population has between 100 and 999 naturally occurring rooted crowns. Plants occur in suitable habitat (mesic woodland, river terraces, or partially shaded lawn) where the disturbance regime is maintained by natural processes (such as large mammal trampling, canopy gap creation, stream scouring); **or** in somewhat suitable habitat maintained by anthropogenic activities (old roads, jeep trails, "skidder" trails, old cemeteries, savannah-like lawns at old home sites) where disturbance for a prolonged period (such as mowing, grazing, trampling, or logging) is mild to moderate.

C	Population has between 30 and 99 naturally occurring rooted crowns. Plants occur in suitable habitat (mesic woodland, river terraces, or partially shaded lawn) where the disturbance regime is maintained by natural processes (such as large mammal trampling, canopy gap creation, stream scouring); **or** in somewhat suitable habitat maintained by anthropogenic activities (old roads, jeep trails, "skidder" trails, old cemeteries, savannah-like lawns at old home sites) where disturbance for a prolonged period (such as mowing, grazing, trampling, or logging) is curtailed or limited.
D	Population has between 1 and 29 naturally occurring rooted crowns. Plants occur in suitable habitat (mesic woodland, river terraces, or partially shaded lawn) where the disturbance regime is maintained by natural processes (such as large mammal trampling, canopy gap creation, stream scouring); **or** in somewhat suitable habitat maintained by anthropogenic activities (old roads, jeep trails, "skidder" trails, old cemeteries, savannah-like lawns at old home sites) where disturbance for a prolonged period (such as mowing, grazing, trampling, or logging) is curtailed or limited.

3.5. Conservation Needs and Threats

In 1995, the Running Buffalo Clover Recovery Team identified eight major threats to the species: 1) any irreversible, permanent habitat loss such as road construction, that completely destroys the habitat and/or kills all plants and seeds within the path of the disturbance; 2) the closing of forest canopies through succession to the point of severe shading, leading to reduced flower and fruit production; 3) the elimination of bison leading to reduced seed dispersal and release of competing vegetation; 4) small population size and associated fragility and susceptibility to catastrophe; 5) excessive herbivory; 6) viral and fungal diseases; 7) reduction in pollinators; and 8) competition from non-native invasive species (USFWS 2007, 2008). The major threats to the species throughout its range are habitat destruction and modification, habitat succession, invasive plant competition, and small population size at individual sites.

Habitat Destruction and Modification

Patches of running buffalo clover have been lost to land development, resulting in isolated, remnant populations (Cusick 1989). Alterations to forest canopies (e.g., tree removal) can alter the specific filtered light conditions required by the species and render areas unsuitable (Cusick 1989, Homoya et al. 1989, Burkart et al. 2013, USFWS 2017).

Habitat Succession

Habitat succession results in closed canopies that provide too much shade and competition for the species. Running buffalo clover persists in areas that receive periodic disturbance that maintains open understories and reduces competition. Bison grazing may have served this role historically (Jacobs and Bartgis 1987, Homoya et al. 1989). Additionally, bison may have uniquely provided important soil enrichment, seed dispersal, and seed scarification necessary to

maintain running buffalo clover (Jacobs and Bartgis 1987). Though cattle grazing has replaced bison grazing on the landscape in the range of the species, the duration and the timing of cattle grazing may not equally replace the disturbance created by the migratory patterns of bison (USFWS 2007). Despite these differences, running buffalo clover success in some areas is associated with the disturbance created by cattle grazing (Fields and White 1996, White et al. 1999, Perkins 2015). Running buffalo clover is also found in areas that experience disturbance from roads, trails, forest management practices, stream scour, and mowing (Madarish and Schuler 2002, USFWS 2007, Burkart et al. 2013, USFWS 2017). Addressing the threat of habitat succession will likely entail active, adaptive management in many cases.

Invasive Plant Competition

Invasive plant species outcompete running buffalo clover. Non-native white clover (*Trifolium repens*) may invade the habitat of running buffalo clover, out-competing it for available resources (Jacobs and Bartgis 1987). Other invasive plants that compete with running buffalo clover include Japanese stilt grass (*Microstegium vimineum*), garlic mustard (*Alliaria petiolata*), Japanese honeysuckle (*Lonicera japonica*), Amur honeysuckle (*Lonicera maackii*), wintercreeper (*Euonymus fortunei*), and periwinkle (*Vinca minor*).

Small Population Sizes

Genetic studies of running buffalo clover have been conducted rangewide. The results from allozyme electrophoresis (Hickey et al. 1991) and random amplified polymorphic DNA markers (RAPD) (Crawford et al. 1998) show relatively low levels of diversity and low levels of gene flow between populations, even between those separated by short distances. In contrast, the results from the two techniques differ in that RAPD marker variation was detected in all populations sampled, with levels of diversity in several smaller populations equal to that in larger ones. The RAPD study suggested that to conserve maximum levels of diversity in running buffalo clover, as many populations as possible should be preserved across its range because small populations of running buffalo clover contribute as much genetic diversity as large populations and exhibit unique banding patterns. Maintaining the genetic diversity of the species is important for adaptability and genetic stability. Small populations are more likely to become extirpated. Research on individual patches at the Bluegrass Army Depot in Kentucky indicates that the probability of persistence for a patch increases with size (Dart-Padover et al. 2016).

4. ENVIRONMENTAL BASELINE

The Environmental Baseline analyzes the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat, and the ecosystem within the Action Area. The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review.

4.1. Action Area Numbers, Reproduction, and Distribution

The Service considers all the running buffalo clover plants in the Action Area as a single A-ranked population (referred to as Scrubgrass Creek in the 5-Year Review) (USFWS 2017). Mr. Larry Brewer of NKU CER conducted initial surveys for the species on July 9 and 12, 2013 in Tract 1 and May 28-29, 2014 in Tract 2. Since then Mr. Brewer has revisited the Action Area numerous times to conduct extensive ongoing studies of the patches. Four additional patches have been found since the initial surveys. To date, fifteen running buffalo clover patches have been recorded on the Kingsolver site (Fig. 1).

All fifteen patches were revisited in 2018 to count or estimate the number of rooted crowns. Based on these surveys, the Kingsolver site has an estimated total of 1,723 rooted crowns across all the patches, with patch sizes ranging from two to an estimated 1,116 rooted crowns (Table 2). All of the patches are located near on-site stream channels and likely benefit from the disturbance caused by the natural stream scour.

Five of the recorded running buffalo clover patches are at least partially within the direct disturbance areas of the proposed Action (i.e., within the construction limits or the access roads). Patch #10 is completely within the direct disturbance limits. About 10% of patches #4, #5, and #6 are within the direct disturbance limits, and 5% of patch #8 is within the disturbance limits.

Table 2. The number of rooted crowns and flowering heads at each running buffalo clover patch in the Action Area.

Patch #	# of rooted crowns	# of flowering heads	% of patch within direct disturbance areas	# of plants within direct disturbance areas
1	9	8	0	0
2	36	3	0	0
3	21	1	0	0
4	9	0	10	1
5	18	0	10	2
6	22	0	10	2
7	55	3	0	0
8	1,116	169	5	22
9	199	64	0	0
10	85	111	100	85
11	108	7	0	0
12	7	0	0	0
13	2	0	0	0
14	22	1	0	0
15	14	5	0	0
Total	**1,723**	**-**	**-**	**112**

Because of the high concentration of running buffalo clover on the site, it is likely that there are unrecorded small patches and individual plants, especially in Tract 1. In addition, there are likely seeds in the soil throughout many of the riparian areas in Tract 1. However, we are unable to quantify the number of unrecorded running buffalo clover plants or seed in the Action Area based on the available data.

4.2.Action Areas Conservation Needs and Threats

Of the conservation needs of the species listed in section 3.5, habitat succession and invasive plant competition are the most relevant to the Action Area. Several of the patches are located in disturbed historic roadbeds that likely facilitated favorable conditions for the species. The Amur honeysuckle and multiflora rose throughout the site threaten to outcompete running buffalo clover on the site.

5. EFFECTS OF THE ACTION

This section analyzes the direct and indirect effects of the Action on running buffalo clover, which includes the direct and indirect effects of interrelated and interdependent actions. Direct effects are caused by the Action and occur at the same time and place. Indirect effects are caused by the Action, but are later in time and reasonably certain to occur.

Based on the description of the Action in section 2.0 and the species' biology in section 3.0, we have identified six stressor(s) to the running buffalo clover (i.e., the alteration of the environment that is relevant to the species) that may result from the Action. These stressors are associated with components of the Action in Table 3 and with specific activities of the construction component in Table 4.

In the following subsections, we discuss the best available science relevant to each stressor. Then, we describe the Stressor-Exposure-Response pathways that identify the circumstances for the plant's exposure to the stressor (i.e., the overlap in time and space between the stressor and individual plants). Finally, we identify and consider how proposed conservation measures may reduce the severity of the stressor or the probability of an individual plant's exposure for each pathway.

Table 3. Stressors caused by action components.

	Construction	Planting	Maintenance & Monitoring	Site Protection	Long-term Management
Crushing	x				
Soil disturbance	x				
Soil compaction	x				
Change in light regimes	x	x		x	
Exposure to herbicide			x		x

Table 4. Stressors caused by specific activities in the construction component.

	Grubbing	Grading & Filling	Excavation	Placement of Structures
Crushing	x	x	x	x
Soil disturbance		x	x	
Soil compaction	x	x	x	x
Change in light regimes	x			

5.1. Crushing

During construction, equipment will be driven over the Action Area to complete construction activities including grubbing, grading and filling, excavation, and placement of structures. This and placement of structures could crush running buffalo clover plants.

Applicable Science

Driving equipment over plants can damage plants, resulting in reduced growth (Hakensson et al. 1988).

Effects Pathway # 1	
Activity: All construction activities	
Stressor: Crushing	
Exposure (time)	Any time during two-year construction phase.
Exposure (space)	Along riparian corridors, in channels, and in access roads to site.
Resource affected	Individual plants; 5-10% of plants in patches #4, #5, #6, and #8 and an indeterminable number of plants and seeds in areas not known to contain the species.

Individual response	• Damage to foliage/flower will require increased energy expenditure to repair damage which could result in reduced chances of survival and/or reduced fecundity. • Damage to foliage will reduce the ability to photosynthesize which could result in reduced chances of survival and/or reduced fecundity. • Damage to flowers will reduce fecundity.
Conservation measures	• Running buffalo clover patches will be demarcated with flagging tape to reduce the chance of accidental intrusion in these areas. • Access roads will be routed to minimize impacts to known running buffalo clover locations. • Wooden construction mats or plywood will be used to cover running buffalo clover plants where equipment will be moved across them to more broadly distribute equipment weight across the soil and plants to minimize damage. • Construction activities will be timed so that running buffalo clover patches are not disturbed during the flowering season (April 15 – June 15).
Interpretation	Driving construction equipment over running buffalo clover plants while conducting work or accessing the site and placement of structures in the channels would damage plants.
Effect	Significant, adverse

5.2. Soil disturbance

Earth moving activities during grading and filling and excavation will uproot plants; bury plants; sever stolons; move seeds, plants, and portions of plants to different locations; and change conditions of the soil. The vast majority of these activities will occur during the construction phase, but some minor additional work may occur during maintenance and monitoring in specific areas that require spot treatments.

Applicable Science

Running buffalo clover is dependent on some level of disturbance. In a Hidden Valley, Indiana, residential backyard, running buffalo clover was observed after the yard had been disturbed in an effort to re-establish grass (Finfera 2018, per. comm.). These plants most likely germinated from seeds that had been previously deposited in the seedbank. Disturbance can sever stolons from plants, and those stolons can take root and become new plants (Hickey 1994). Anecdotal evidence demonstrates that running buffalo clover plants do not tolerate uprooting well, even when translocated to habitat that superficially appears suitable. A few translocated plants have survived in the short-term, but have not persisted long-term (USFWS 2017).

Effects Pathway #3	
Activity: Grading & filling, excavation	
Stressor: Soil disturbance	
Exposure (time)	Any time during two-year construction phase.

Exposure (space)	Along riparian corridors and in the channels.
Resource affected	Seeds, plants, and habitat
Individual response	• Burying plants will inhibit their ability to photosynthesize and will result in death. • Uprooted plants and severed stolons moved to areas where they cannot uptake sufficient water/nutrients will result in death. • Uprooted plants and severed stolons moved to more favorable locations would experience increased growth or establishment of new plants. • Uprooted plants and severed stolons moved to less favorable locations would experience decreased growth and decreased chances of survival. • Seeds moved to more favorable positions in the soil would experience increased chances of germination. • Seeds moved to less favorable positions in the soil would experience decreased chances of germination. • Creation of more favorable soil conditions would increase the chance of seed germination and stolon rooting, and/or increase plant growth. • Creation of less favorable soil conditions would decrease the chance of seed germination and stolon rooting, and/or decrease plant growth.
Conservation Measures	• Grading, filling, and excavation will avoid all recorded running buffalo clover patches, except patch #10. • The plants in patch #10 will be transplanted to an area with suitable habitat and monitored. • Running buffalo clover patches will be demarcated with flagging tape to reduce the chance of accidental intrusion in these areas.
Interpretation	Earthmoving activities will kill some individual plants and portions of plants by uprooting and/or covering them with soil. Individual running buffalo clover plants in patch #10 will be dug up with hand shovels and translocated to a site with suitable habitat. This conservation measure will provide an opportunity for these individuals to survive; however, based on previous translocations, they will not likely persist long-term. Stolons and seeds will be moved to different locations, horizontally and/or vertically, in the soil. The earthmoving activities will change the conditions of the soil and could result in conditions more or less favorable for seed germination, stolon rooting, or plant growth.
Effect	Significant, adverse; or beneficial

5.3. Soil Compaction

During construction, equipment will be driven over the Action Area to complete construction activities including grubbing, grading and filling, excavation, and placement of structures. This will compact soil in portions of the Action Area.

Applicable Science

Many studies have found soil compaction to reduce yields of agricultural crops. The following factors influence the amount of soil compaction that occurs from driving tractors over fields, from most influential to least influential: soil moisture content, number of passes, tractor weight, wheel equipment (singles or duals), tire pressure, speed, and draft (Hakansson et al. 1988). Soil compaction can reduce plant growth and seed germination by changing soil properties, especially bulk density, strength, porosity, and pore connectivity (Nawaz et al. 2013). Soil compaction can persist for years, especially in severe cases where the compaction extends deep within the soil (Hakensson et al. 1988).

Effects Pathway #4	
Activity: All construction activities	
Stressor: Soil compaction	
Exposure (time)	Any time during two-year construction phase; soil condition would persist for a few years after construction.
Exposure (space)	Along riparian corridors and access roads.
Resource affected	Soil; 5-10% of area in patches #4, #5, #6, and #8 and areas with unrecorded plants.
Individual response	• Decreased seed germination. • Decreased ability for runners to take root.
Conservation measures	• Running buffalo clover patches will be demarcated with flagging tape to reduce the chance of accidental intrusion in these areas. • Access roads will be routed to minimize impacts to running buffalo clover patches. • Wooden construction mats or plywood will be used to cover running buffalo clover plants where equipment will be moved across them to more broadly distribute equipment weight across the soil and plants to minimize compaction.
Interpretation	Soil compaction in running buffalo clover patches could reduce growth and restrict seed germination. Soil compaction in other areas could reduce the chances of running buffalo clover seeds from germinating. Because of the avoidance of most of the running buffalo clover patches, the relatively small size of construction equipment, the relatively short duration of the construction activities, and the implementation of conservation measures, we expect minimal effects to running buffalo clover from soil compaction.
Effect	Insignificant

5.4. Change in Light Regimes

Shrubs and trees will be removed during grubbing, which will change the canopy cover in those areas. The shrub and tree plantings in the riparian zone after construction will provide additional

shade in replanted areas. The restriction of future activities through the site protection will result in natural forest succession and associated changes in light regimes.

Applicable Science

Running buffalo clover requires filtered light conditions and can benefit from forest thinning or logging operations (Burkhart 2013; Madarish and Schuler 2002). Too much loss of forest canopy can be detrimental to running buffalo clover by allowing in too much sunlight, altering the microclimate, and creating conditions favorable to competing plant species (Madarish and Schuler 2002).

Effects Pathway #5	
Activity: Grubbing; planting; site protection	
Stressor: Change in light regimes	
Exposure (time)	Effects from the alteration of the habitat will persist for years. The effects to the natural succession of the habitat will persist in perpetuity.
Exposure (space)	Along riparian corridors and in the channels
Resource affected	Habitat; individual plants
Individual response	• Favorable light conditions for running buffalo clover would result in increased growth and increased chances of survival and/or increased fecundity. • Less favorable light conditions for running buffalo clover would result in decreased growth and decreased chances of survival and/or decreased fecundity. • Less favorable light conditions for other species would decrease interspecific competition with running buffalo clover resulting in increased growth and increased chances of survival and/or increased fecundity. • More favorable light conditions for other species would increase interspecific competition with running buffalo clover resulting in decreased growth and decreased chances of survival and/or decreased fecundity.
Conservation Measures	• Tree removal will be avoided whenever possible to maintain existing light regimes.
Interpretation	Clearing and grubbing during construction and planting after construction will immediately alter light regimes in habitat, resulting in different conditions that could be more favorable or less favorable for plant growth. We expect this to be minimal at the 10 patches that are not in the disturbance limits, since tree removal and plantings at these sites, if any, would be on the periphery. The altered conditions could also benefit the species by creating more favorable conditions where the species is not currently present. Restricting future tree removal from the Action Area will result in natural succession of the forested habitat that will produce changing conditions that could become more favorable or less favorable for growth.
Effect	Significant, adverse or beneficial

5.5. Exposure to Herbicide

Herbicide may be applied to control invasive species during the maintenance and monitoring period and, to a lesser extent, during the long-term management period.

Applicable Science

Herbicide drift from nearby target species can damage vegetation and affect the reproduction and growth of non-target species (Al-Khatib et al. 1992; Olszyk et al. 2017).

Effects Pathway #6	
Activity: Maintenance and monitoring; long-term management	
Stressor: Exposure to herbicide	
Exposure (time)	Intermittently during the five-year maintenance and monitoring period, typically once or twice during the growing season; occasionally in perpetuity during the long-term monitoring period.
Exposure (space)	Riparian buffers
Resource affected	Individual plants
Individual response	• Damage to tissue and/or physiological processes could lead to decreased chances of survival and/or decreased fecundity
Conservation measures	Herbicides will be applied to cut stumps of invasive species (primarily Amur honeysuckle (*Lonicera maackii*) and multiflora rose (*Rosa multiflora*)) by certified pesticide applicators who are trained at identifying running buffalo clover. All running buffalo clover patches will be flagged. If herbicide applications need to occur within three feet of running buffalo clover, it will be applied to target species using sponges or brushes.
Interpretation	Due to the implementation of conservation measures, we believe that running buffalo clover is unlikely to be exposed to herbicide.
Effect	Discountable

5.6. Summary of Effects

The proposed Action would expose running buffalo clover to six stressors that we have identified. Sections 5.1-5.6 evaluated the effects of the stressors; this is summarized below in Table 4. We have identified the following stressors as likely to adversely affect running buffalo clover: crushing, soil compaction, soil disturbance, and change in light regime. We believe exposure to herbicide would have a discountable effect on the species. In addition to adverse effects, soil disturbance, change in light regime, and permanent protection of the site will have beneficial effects on running buffalo clover.

Table 4. A summary of the effects of the Action.

Stressors	Adverse	Insignificant/ Discountable	Beneficial
Crushing	x		
Soil disturbance	x		x
Soil compaction	x		
Change in light regime	x		x
Exposure to herbicide		x	

6. CUMULATIVE EFFECTS

For purposes of consultation under ESA §7, cumulative effects are the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future federal actions that are unrelated to the proposed action are not considered, because they require separate consultation under §7 of the ESA. No cumulative effects were identified by the applicant and none are anticipated by the Service.

7. CONCLUSION

In this section, we summarize and interpret the findings of the previous sections (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA, which is to determine whether a Federal action is likely to:

a) jeopardize the continued existence of species listed as endangered or threatened; or
b) result in the destruction or adverse modification of designated critical habitat.

"Jeopardize the continued existence" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

In our effects analysis, we identified how the Kingsolver running buffalo clover population would be adversely affected by the Action. Of the 15 running buffalo clover patches comprising the Kingsolver population, only one patch is expected to be completely destroyed. A small proportion (5-10%) of plants in four other patches is expected to be adversely affected and may potentially lead to some temporary loss of plants. Across the site, 112 of 1,723 of the running buffalo clover plants, or 6.5%, will be impacted by the Action. Only 85 plants are expected to be potentially destroyed. The other impacted plants will likely survive and recover from the stressors. The 1,638 plants remaining in the population after construction of the mitigation site would still comprise enough individuals to qualify as an A-ranked population. The population will benefit from the invasive species control during the 5-year maintenance and monitoring phase and the site protection for perpetuity. Additionally, we expect some new patches of

running buffalo clover to develop across the site in response to ground disturbance and creation of canopy gaps.

The running buffalo clover population in the Action Area is one of 16 A-ranked populations range-wide, and one of 152 running buffalo clover populations range-wide. The number of plants we expect to be adversely affected by the proposed Action make up approximately 6.5% of the total plants in the population. We do not expect the proposed Action to significantly change the population's contribution towards the recovery of the species. After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action and the cumulative effects, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the running buffalo clover.

8. INCIDENTAL TAKE STATEMENT

This BO evaluated effects of the Action on the endangered running buffalo clover, a species of plant. The prohibitions in ESA §9 and regulations issued under §4(d) that prohibit the take of fish and wildlife species do not apply to plants. Therefore, this BO does not include an incidental take statement.

8.1 Reasonable and Prudent Measures

The Service can include reasonable and prudent measures (RPMs) that are necessary or appropriate to minimize the impact of incidental take caused by the Action on listed wildlife species. Because there is no prohibition of incidental take of plants, this BO does not include RPMs.

8.2 Terms and Conditions

Terms and conditions (T&Cs) are mandatory steps for successful implementation of the RPMs. Because there are no RPMs in this BO, there are also no corresponding T&Cs.

8.3 Monitoring and Reporting Requirements

This section describes specific instructions for the Action Agency to monitor the impacts of the incidental take. Because there is no prohibition of incidental take of plants, this BO does not include any monitoring and reporting requirements.

9. CONSERVATION RECOMMENDATIONS

§7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by conducting conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary activities that an action agency may undertake to avoid or minimize the adverse effects of a proposed action, implement recovery plans, or develop information that is useful for the conservation of listed species. The Service offers the

following recommendations that are relevant to the listed species addressed in this BO and that we believe are consistent with the authorities of the Corps.

- Request that NKU CER include a current count of the running buffalo clover plants at each of the existing patches with their Year 1, Year 3, and Year 5 monitoring reports of the site.
- Request that NKU CER include the numbers and locations of transplanted running buffalo clover plants in the as-built report and provide an annual update on the status (i.e., numbers and general condition) of these plants in each annual monitoring report.
- Request that NKU CER identify areas of extensive soil compaction during construction and perform appropriate remediation (e.g., tilling) in those areas. These remediation activities should not occur in areas with documented running buffalo clover plants.

10. RE-INITIATION NOTICE

Formal consultation for the Action considered in this BO is concluded. Reinitiating consultation is required if the Corps retains discretionary involvement or control over the Action (or is authorized by law) when:

a) new information reveals that the Action may affect listed species or designated critical habitat in a manner or to an extent not considered in this BO;
b) the Action is modified in a manner that causes effects to listed species or designated critical habitat not considered in this BO; or
c) a new species is listed or critical habitat designated that the Action may affect.

This consultation was assigned FWS ID #04EK1000-2018-F-1977. Please refer to this number in any correspondence concerning this consultation.

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